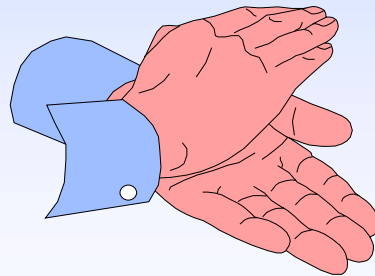


WELCOME

**ATC 2070 & ITS CABINET WORKSHOP
SPONSORED BY CALTRANS**



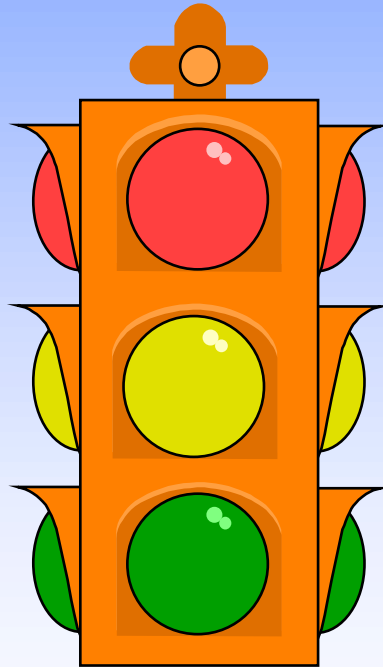
2070 & ITS CABINET WORKSHOP - AUGUST 2001

ATC 2070 WORKSHOP

**MARTHA STYER - OFFICE CHIEF,
ITS DEVELOPMENT AND SUPPORT
TRAFFIC OPERATIONS
CALTRANS H.Q., SACRAMENTO**



CALTRANS' ROLE ATC - ITS WORLD



■

- **WHERE WE ARE NOW**
 - ITS STATUS
 - ACCOUNTABILITY
- **WHERE WE ARE GOING**
 - CALTRANS “GRAND” MASTER PLAN
 - USE OF CONSULTANTS
 - PROJECT MANAGER ROLE
 - GENERAL BLUEPRINT



WORKSHOP AGENDA

INTRODUCTION

ATC MODEL 2070 CONTROLLER UNIT

MODEL 2070 APPLICATION PROGRAMS

ITS CABINET FAMILY

TRAINING ASSESSMENT

FLOYD WORKMON



SESSION 1 - MODEL 2070

**ADVANCED TRANSPORTATION CONTROLLER UNIT
AS SPECIFIED IN CHAPTERS 9 & 10 OF TEES 11/19/99
DOCUMENT AND CURRENT ERRATA.**

- **THE ATC UNIT IS MODULAR, INTER-CHANGEABLE MODULES, MULTI-APPLICATION.**
- **IT WAS DEVELOPED TO JOIN THE 170 CONTROLLER FAMILY. IT INTERFACES WITH NEMA TS 1&2 AND 170 CABINET FAMILIES. IN ADDITION, IT IS A MATED PAIR TO THE NEW ITS CABINET FAMILY**
- **THERE HAS BEEN OVER 26 APPLICATIONS IDENTIFIED FOR THE ATC.**



5 VERSIONS

- **2070 V (VME) UNIT - 170 & TS 2 CABINET**
- **2070 L (LITE) UNIT - 170 & TS 2 CABINET**
- **2070 LC (LITE) UNIT - ITS CABINET**
- **2070 VN (VME & NEMA) – TS 1 CABINET**
- **2070 LN UNIT (LITE & NEMA) – TS 1 CABINET**

2070 V UNIT

- **2070 CHASSIS**
- **CENTRAL PROCESSING UNIT 1A - DUAL BOARD MODULE WITH VME MASTER / SLAVE CAPABILITY**
- **FIELD I/O MODULE 2A OR 2B**
- **FRONT PANEL 3A**
- **POWER SUPPLY 4A**
- **VME CAGE ASSEMBLY 5**

2070 LITE UNIT

- **CHASSIS**
- **CENTRAL PROCESSING UNIT 1B - SINGLE BOARD WITH ETHERNET & SERIAL PORT 8**
- **FIELD I/O MODULE 2A OR 2B**
- **FRONT PANEL 3B**
- **POWER SUPPLY 4A OR 4B**

2070 LC UNIT

- **CHASSIS**
- **CENTRAL PROCESSING UNIT 1B**
- **FIELD I/O MODULE 2B OR NONE ***
- **FRONT PANEL 3B OR 3C**
- **POWER SUPPLY 4A OR 4B**

OTHER MODULES

- **BEE BOX**
- **CENTRAL PROCESSING UNIT 1C (FUTURE API)**
- **6A TWO MODEMS AND/OR 1200 BPS EIA
232 SERIAL PORT**
- **6B TWO MODEMS AND/OR UP TO 9600 BPS EIA
232 SERIAL PORT**
- **6D FIBER OPTIC COMM**
- **7A TWO COMM CHANNELS - EIA/TIA 232**
- **7B TWO COMM CHANNELS - EIA/TIA 485**
- **8 NEMA MODULE FOR TS 1 INTERFACE**



COST

2070 V (VME) UNIT = \$2,800 - \$3,200

2070 L (LITE) UNIT = \$2,000 - \$2,200

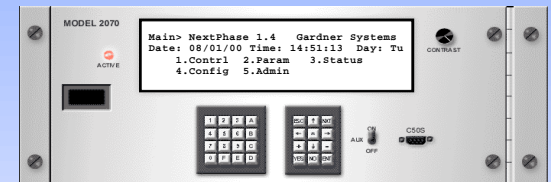
2070 LC (LITE/COMM) UNIT = \$1,300 - \$1,600

2070-8 (NEMA) MODULE = \$600 - \$800



SESSION 1.2

2070 OPERATING SYSTEM



CRAIG GARDNER

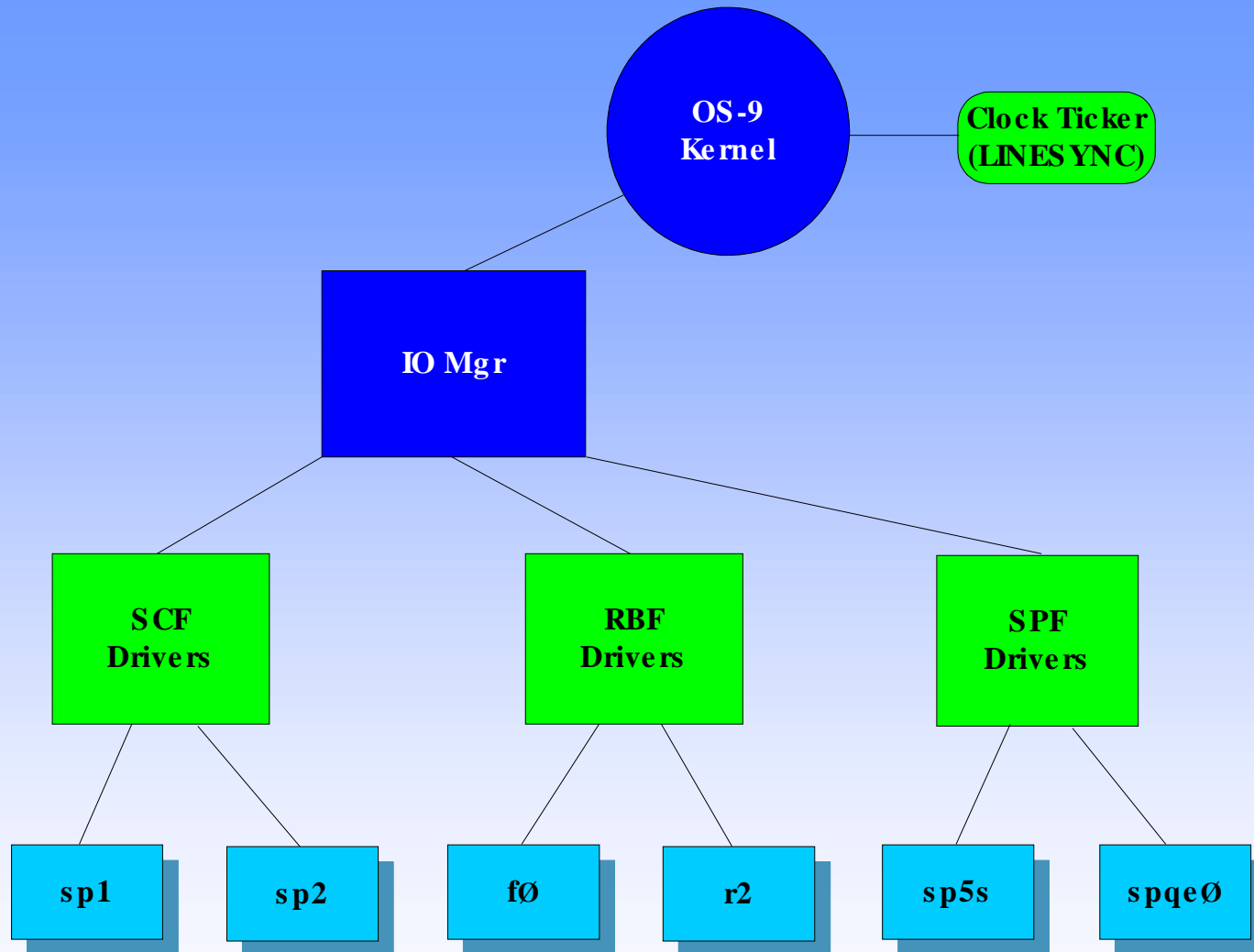
OPERATING SYSTEM

- **OS-9 RTOS by Microware**
- **Device driver API layer**
 - **Allows applications portability to any 2070**
 - **Simplifies access to controller features**
 - **Support for ATC API with compatible library**

OS-9 RTOS

- . REAL-TIME KERNEL**
- . UNIFIED I/O**
- . MULTI-TASKING**
- . UNIX-LIKE API**
- . HAWK DEVELOPMENT IN C, C++**





DEVICE DRIVERS

- **Storage:** **Non-volatile & volatile Ramdisks**
- **Comms:** **Synchronous & Asynchronous serial**
- **Clock/Timers:** **Calendar / DST; hardware timers;
clock synchronization**
- **Peripheral Devices:** **LCD display; activity LED; field I/O;
power fail handling**
- **Network:** **Ethernet**

EXAMPLE “C” CODE SAMPLE

❖ Open the LED device named “/led”

```
_os_open("/led", S_IREAD/S_IWRITE, &led_path);
```

❖ Turn on LED device

```
char led_state = 1;      /* state = ON */  
u_int32 count = 1;      /* send one byte to driver */  
_os_write(led_path, &led_state, &count);
```

❖ Turn off LED device

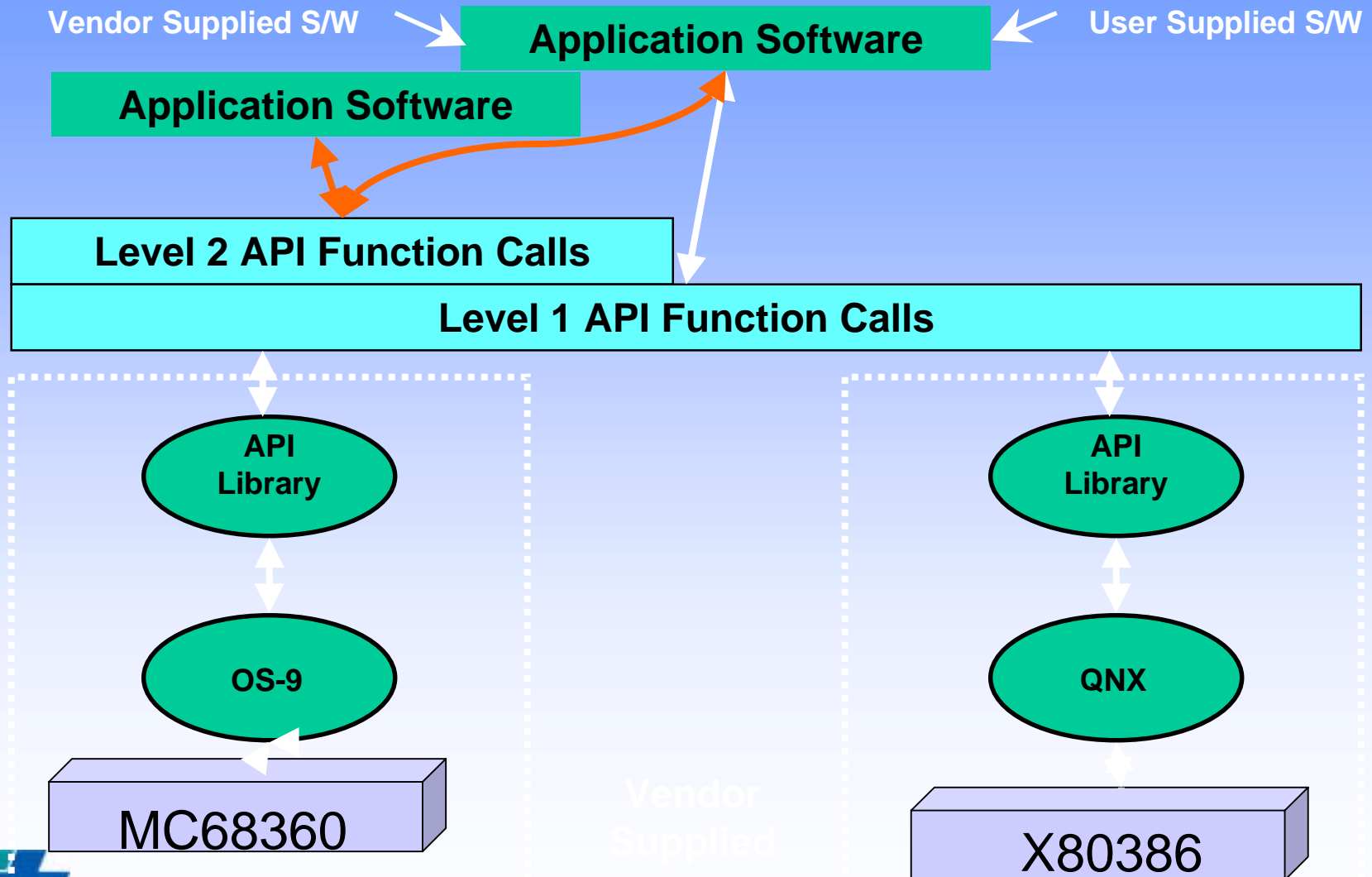
```
led_state = 0;  
count = 1;  
_os_write(led_path, &led_state, &count);
```

❖ Close LED device

```
_os_close(led_path);
```



Application Programming Interface



SESSION 1.3

CENTRAL PROCESSOR UNITS (CPU) AND VME SYSTEM

DAVE MILLER



2070 & ITS CABINET WORKSHOP - AUGUST 2001

CENTRAL PROCESSOR UNITS (CPU)

- **CPU is the “BRAINS” of the 2070 ATC**
- **Includes microprocessor, memory and mass storage**
- **Currently, two CPU versions, 2070-1A and 2070-1B**
- **2070-1A: Two board version with parallel expansion**
- **2070-1B: One board version with serial expansion**
- **Planned, 2070-1C: Processor and OS independent**



2070-1A & 2070-1B COMMON FEATURES

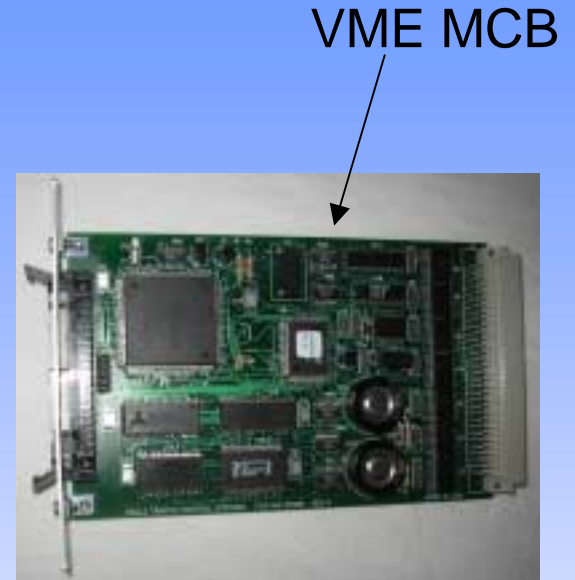
- **Memory Types and Capacities**
 - 4 Megabyte minimum FLASH drive
 - 512 Kbytes minimum capacitor-backed SRAM
 - 4 Megabytes minimum DRAM
- **68360 Microprocessor, 24.576 MHz**
- **Time of day (TOD) clock, including day, date**
- **Super capacitor backup for TOD and SRAM, 10 days min when removed from controller, 30 days min when installed**
- **OS-9 operating system with 2070 extensions**
- **Data_Key holder and removable data_key**



2070-1A TWO BOARD CPU

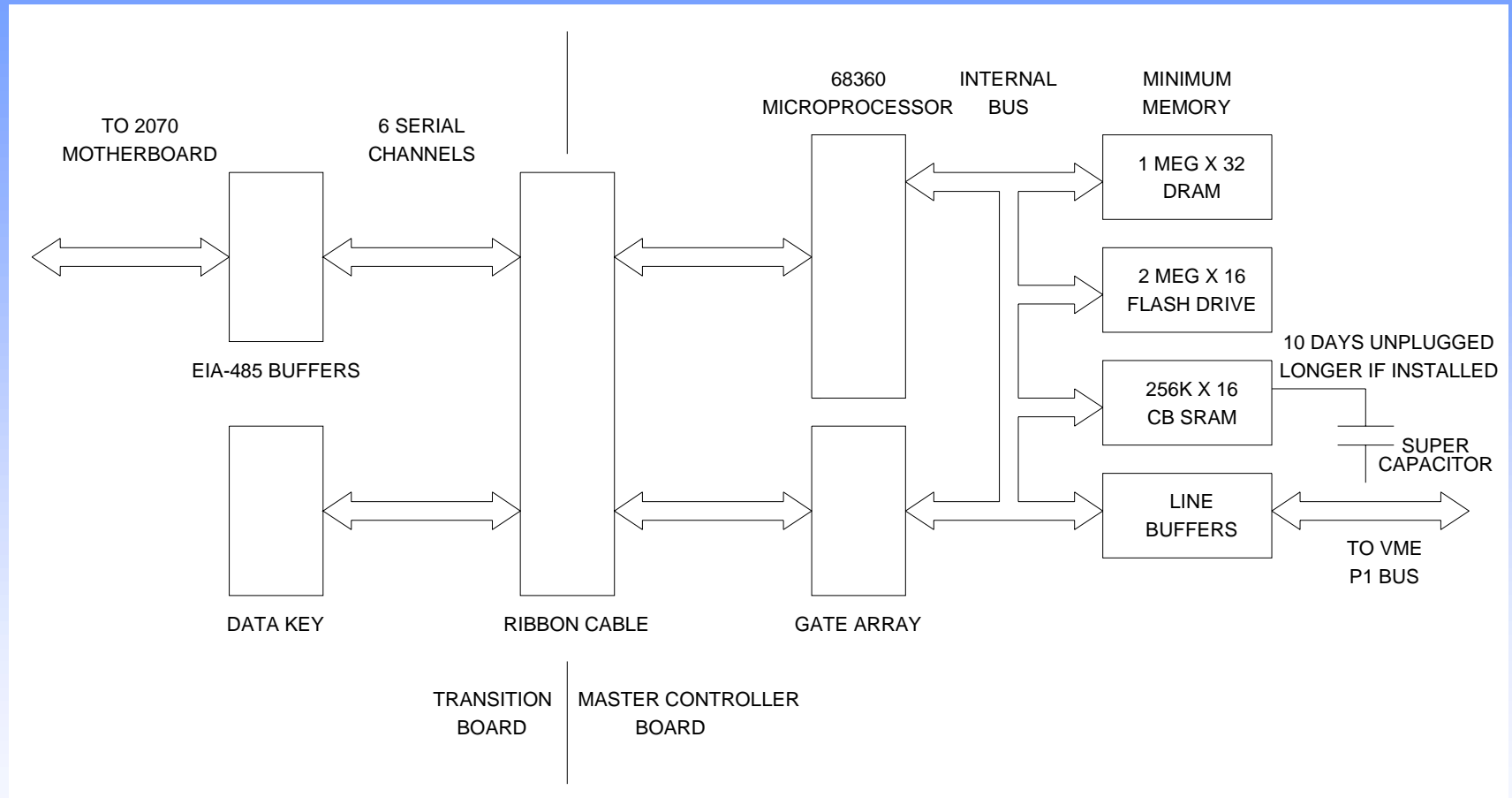


2070-1A CPU



TRANSITION BOARD

2070-1A CPU BLOCK DIAGRAM

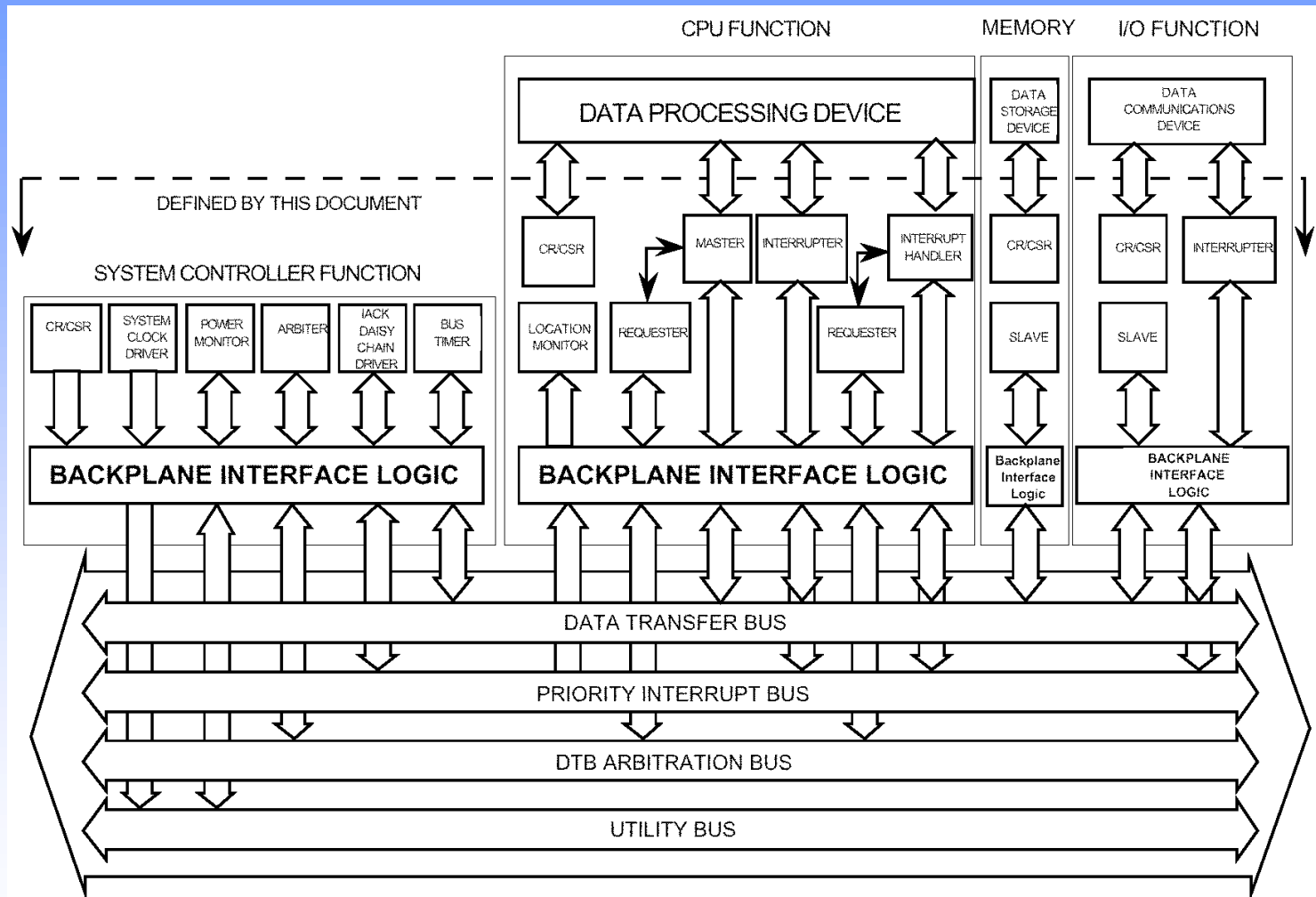


2070-1A CPU VME EXPANSION

- Expansion via parallel Versa Module Europe (VME) bus
- VME is a worldwide standard for hardened computers
- Used in military, petrochemical and robotic applications
- P1 8/16/32/64-bit multi-processor, bus request/grant
- 3U half-height with 96 pin DIN connector
- 2070-1A MCB occupies one slot, 4 spare expansion slots
- Hundreds of standard VME modules from multiple vendors (see www.vita.com for listing of vendors and products)



2070-1A VME P1 BUS (96 PINS)



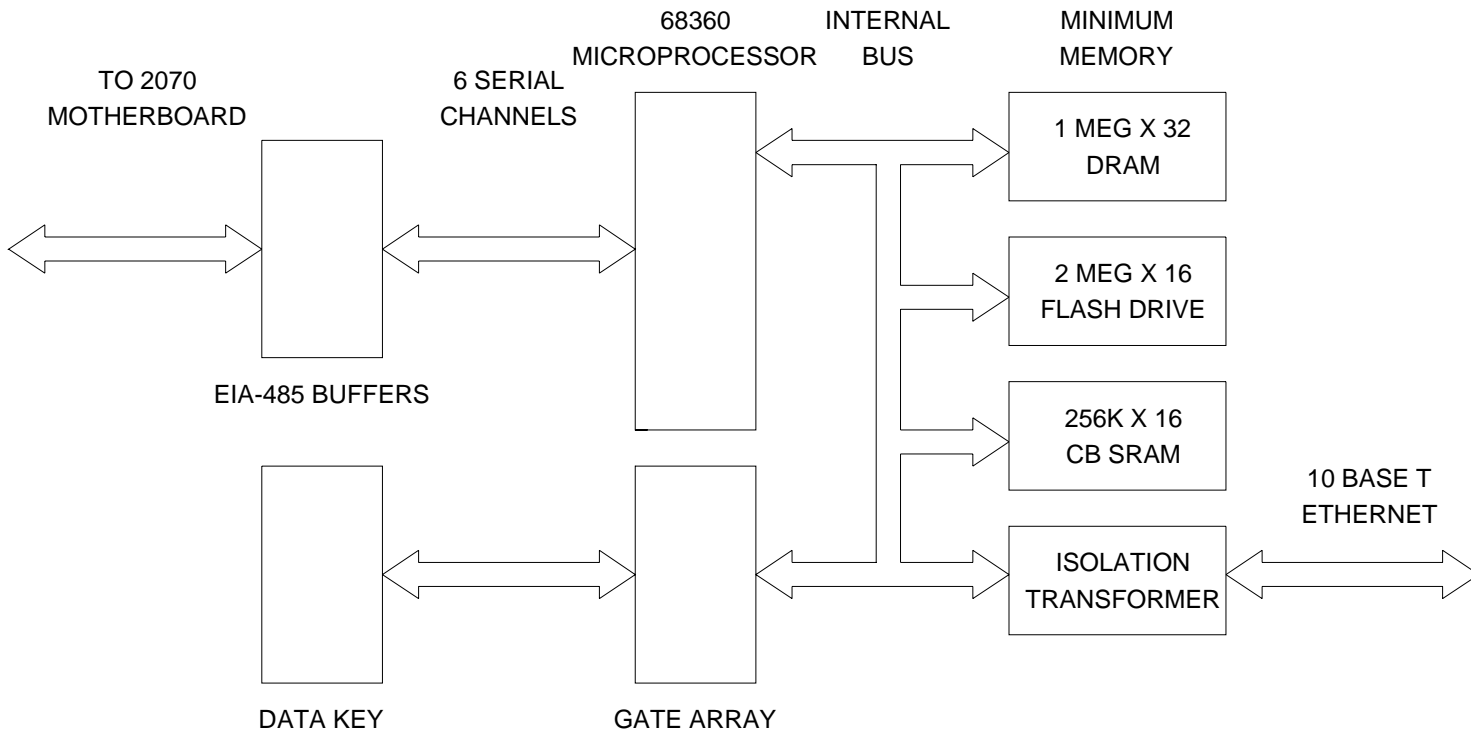
VME INTEGRATION

- **VME modules require special software drivers**
- **Similar to installing new hardware in personal computer**
- **User is responsible for installation of software driver**
- **Be aware that some VME modules do not have OS-9 drivers**

2070-1B SINGLE BOARD CPU



2070-1B CPU BLOCK DIAGRAM



SINGLE BOARD TAKES PLACE OF TRANSITION BOARD

2070-1B CPU ETHERNET EXPANSION

- **Expansion via serial 10 Base-T Ethernet**
- **10 Mega bits per second communications rate**
- **Built-in RJ-45 connector on 2070-1B face plate**
- **Built-in Internet Protocol (IP) address for each CPU**
- **Hundreds of add-on devices from multiple vendors**
- **Commonly used with fiber splitter / Ethernet hub in cabinet**



TRADITIONAL TYPE 170 CPU OPERATION

- **Controller handles single application (traffic, ramp etc)**
- **Application object code located in PROM memory device**
- **Application executes directly from PROM memory device**
- **Software updated by reprogramming PROM memory device**
- **Software is developed for specific microprocessor, must be rewritten when hardware becomes obsolete**

2070 ATC CPU OPERATION

- Operates as a general purpose computer
- Patterned after the IBM PC architectural model, except hardened for unattended operation in harsh environment
- Like a PC, multiple applications stored in FLASH drive
- Application software launched from drive, similar to .BAT
- Like a PC, software is loaded from drive to DRAM
- Application in DRAM accesses drive for data storage
- Like a PC, software is compatible with new hardware & OS



FREEWAY MANAGEMENT EXAMPLE

- **Freeway management code is stored in FLASH drive**
- **2070 ATC boots and loads freeway mgmt code into DRAM**
- **2070 ATC continually computes volumes and occupancy**
- **In case of power fail, calculations are stored in CB SRAM**
- **Every 15 min, results are stored to file in FLASH drive**
- **File can be uploaded to central and pasted into WORD doc**
- **Other applications may reside in FLASH drive, ie RAMP**

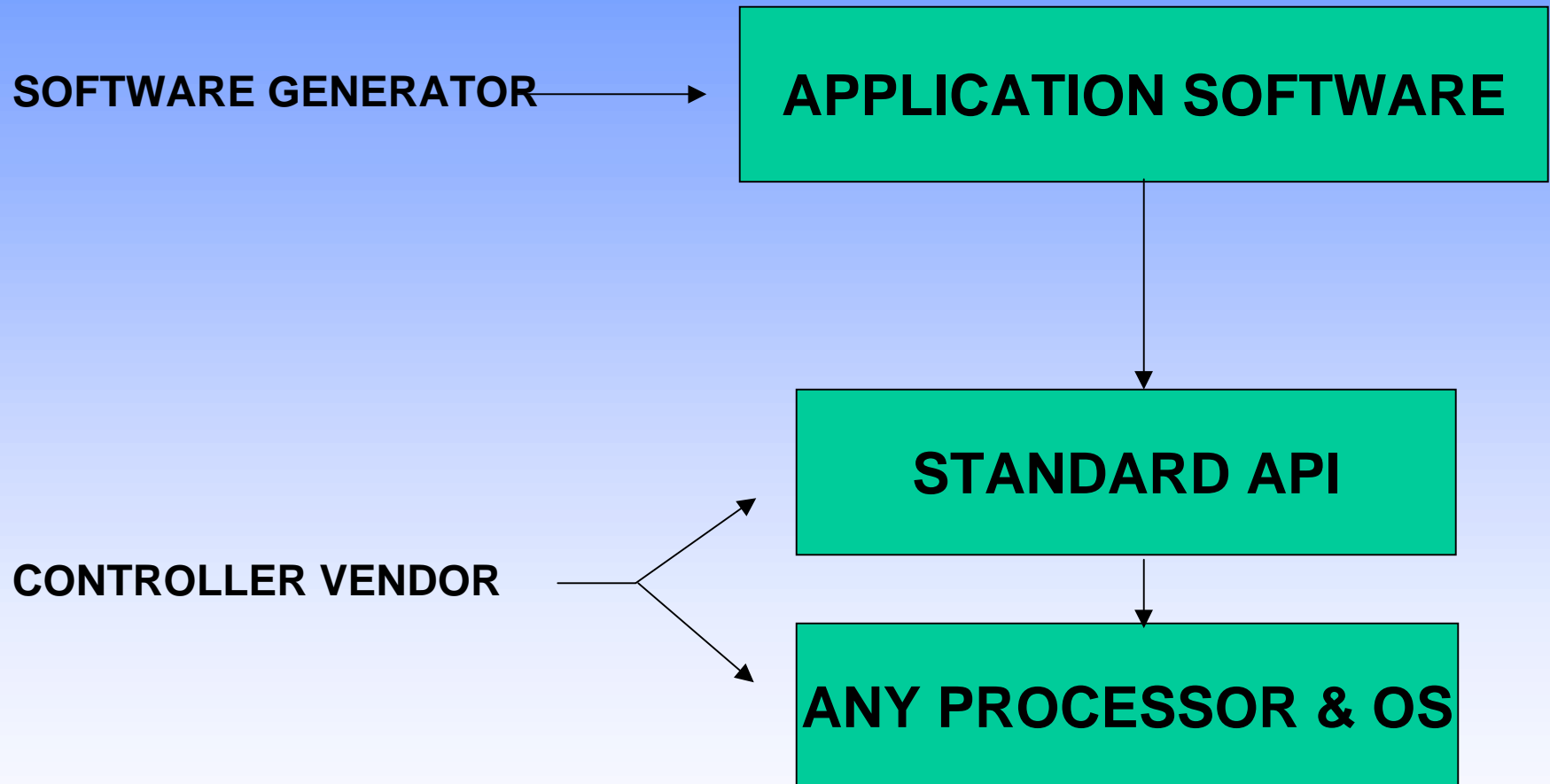


FUTURE 2070-1C CPU

- **Next generation CPU for 2070 ATC, new CALTRANS & NEMA/AASHTO/ITE development specification**
- **Hardware and operating system independent**
- **Upon completion of Application Program Interface (API) OS-9 not required, uses any operating system**
- **Upon completion of API, 68360 not required, uses any processor meeting performance specification**
- **Performance specification for multiple application**
- **Compatible with all software developed for 2070**



2070-1C APPLICATION PROGRAM INTERFACE (API)



SESSION 1.4

MODEL 2070 - 2A & 2B FIELD I/O MODULES

CLYDE NEEL



PURPOSE

2070-2A

- **170 COMPATIBLE I/O TO INTERFACE HOST CABINET**
- **I/O PROCESSING AUGMENTS MAIN CPU**

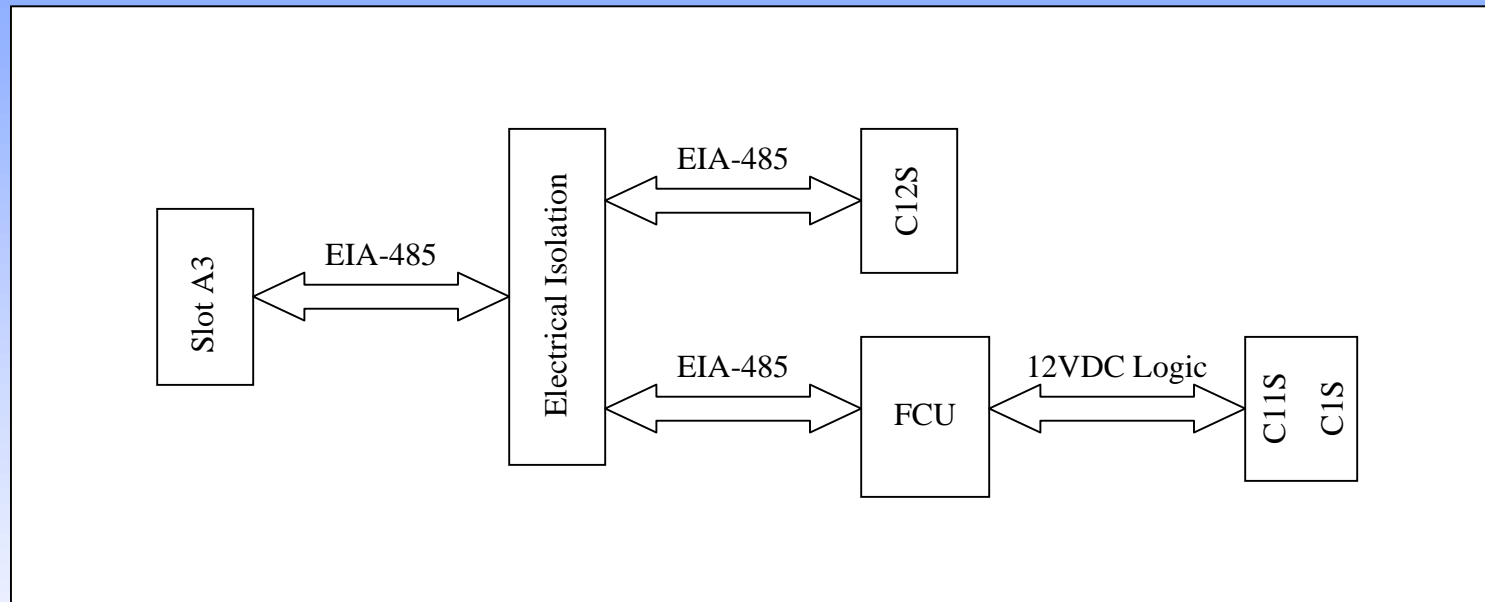
2070-2B

- **INTERFACE ITS CABINET SERIAL BUSES 1 AND 2**
- **CONNECT 2070-8 NEMA INTERFACE UNIT**

2070-2A FEATURE SUMMARY

- **PARALLEL I/O – 64 INPUTS, 64 OUTPUTS**
- **MODULE CONTROL UNIT - FIELD I/O FUNCTIONS**
- **SYNCHRONOUS SERIAL INTERFACES TO CPU
SP5**

2070-2A BLOCK DIAGRAM



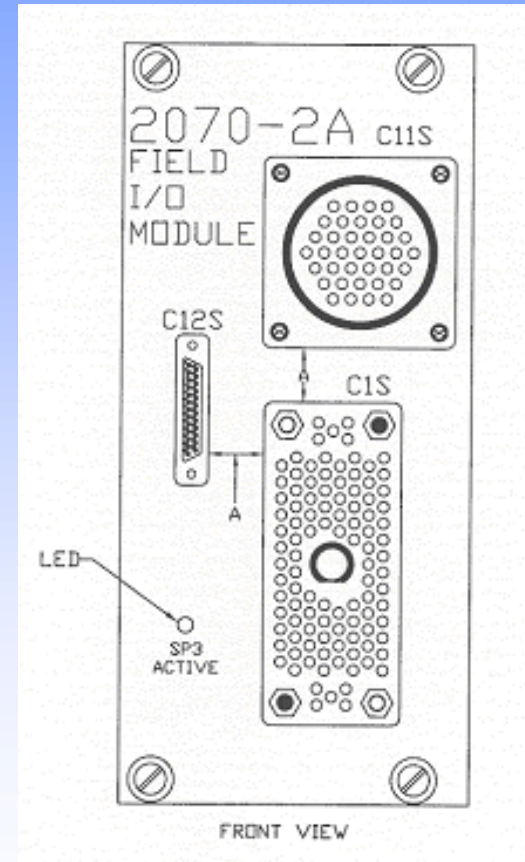
2070-2A FRONT PANEL FEATURES

C1S / C11S

- 170 COMPATIBLE
- 64 INPUTS
- 64 OUTPUTS
- ISOLATED 12VDC

C12S

- SERIAL SP5 AND SP3
- LINESYNC, AC FAIL, AND RESET
- ISOLATED EIA485



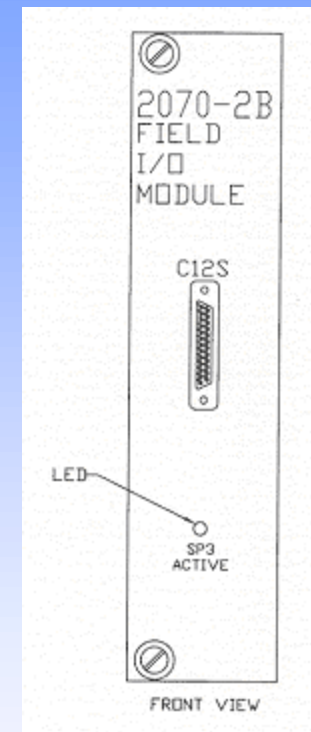
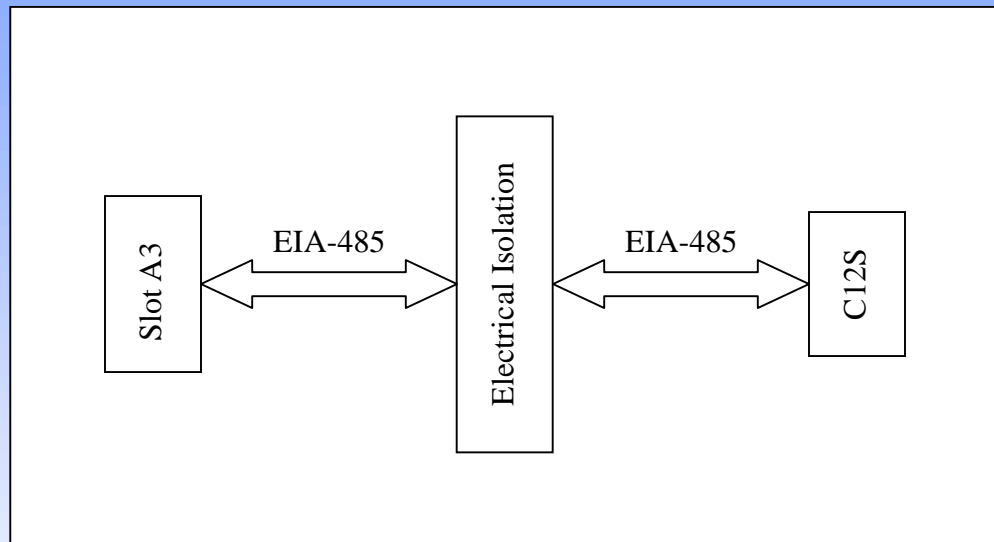
2070-2A PROCESSING

- **FIELD CONTROL UNIT**
 - **EMBEDDED PROCESSOR**
 - **DIAGNOSTICS**
- **INPUTS**
 - **1MS RESOLUTION**
 - **CONFIGURE FILTERING**
 - **BUFFERED TRANSITION MONITORING**

2070-2A PROCESSING

- **OUTPUTS**
 - **TRACKING INPUTS**
 - **SINGLE AND CONTINUOUS PULSE**
 - **GATED AND TRIGGERED**

2070-2B DIAGRAM AND PANEL



SESSION 1.5

FRONT PANELS AND “B” BOX ASSEMBLY

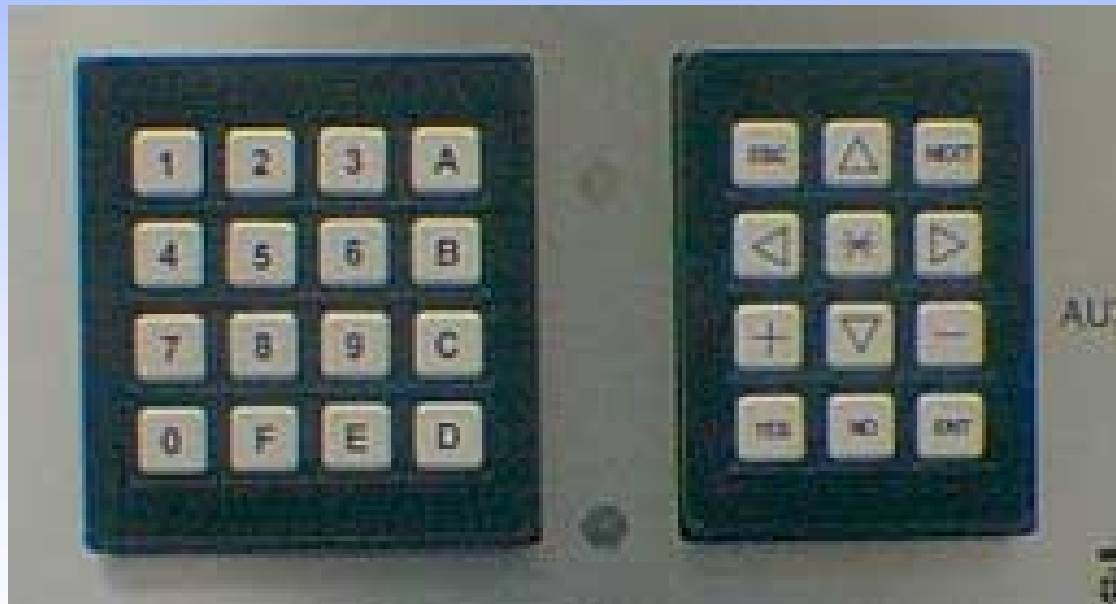
RALPH BOAZ



- **THREE MODELS FOR THE 2070 FRONT PANEL**
 - **2070-3A USES 1/2 INCH CHARACTER 4X40 LCD DISPLAY AND KEYPADS**
 - **2070-3B USES 1/4 INCH CHARACTER 8X40 LCD**
 - **2070-3C NOT DISPLAY OR KEYPADS**

- **LCD FOR THE 2070-3A & 2070-3B MODELS**
 - **4X40 OR 8X40 ELECTRO-LUMINESCENT (EL) BACKLIT DISPLAY**
 - **ILLUMINATES WHEN A KEY IS PRESSED**
 - **CONTRAST CONTROL**
 - **5X8 DOT MATRIX CHARACTERS INCLUDING UNDERLINE**

- **KEYPADS FOR THE 2070-3A & 2070-3B MODELS**
 - **4X4 KEYPAD FOR ALPHANUMERIC ENTRY**
 - **4X3 KEYPAD FOR CURSOR CONTROL AND SYMBOL ENTRY**



- **OTHER FEATURES**
 - CPU ACTIVE LED
 - BELL



- **OTHER FEATURES (CONT.)**
 - **AUXILIARY SWITCH**
 - **C50S CONNECTOR FOR SOFTWARE INSTALLATION AND MANAGEMENT**
 - **VT-100 STANDARD INTERFACE**
 - **INTERCHANGEABLE**



- **2070-3C MODEL**
 - **BLANK PANEL**
 - **ADDS C60P CONNECTOR FOR LAPTOP, PDA, OR A “B-BOX”**
 - **VT-100 STANDARD TERMINAL**
 - **COST EFFECTIVE**

- 2070-3A



- **2070-3B AND “B” BOX ASSEMBLY**



- 2070-3C



SESSION 1.6

MODEL 2070-4 POWER SUPPLY UNITS AND INTERNAL INTERFACE

- 2070-4 POWER SUPPLY UNITS CONSIST OF TWO MODELS 4A AND 4B
- INTERNAL INTERFACE CONSIST OF SERIAL BACKPLANE MOTHERBOARD

RON JOHNSON

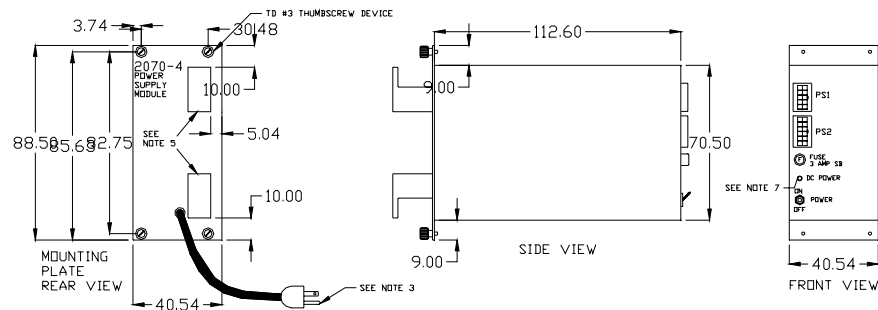
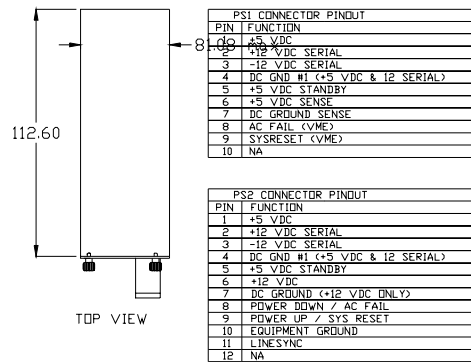


2070-4 UNIT POWER SUPPLIES 4A AND 4B

- **4A HAS A 10 A +5VDC POWER SUPPLY USED WHEN THE VME CAGE ASSEMBLY IS PRESENT.**
- **4B HAS AN 3.5A +5VDC POWER SUPPLY USED ON THE 2070 LITE CONTROLLER UNIT (NON VME).**
- **BOTH HAVE ADDITIONAL VOLTAGE OUTPUTS, +/-12 VDC COMM AT 0.5A AND +12VDC AT 1A, ISOLATION VOLTAGE FOR I/O 2B MODULE.**
- **+5VDC STANDBY POWER TO HOLD UP AT 600 μ A FOR A MINIMUM OF 600 MINUTES.**
- **POWER CONTROL CIRCUITRY TO PROVIDE SYSTEM POWER DOWN-POWER UP OPERATION.**
- **60 HZ LINESYNC**
- **HOLDOVER FOR 0.5 SECOND FOR 30 WATTS TO KEEP THE SYSTEM OPERATING DURING SHORT OUTAGES.**

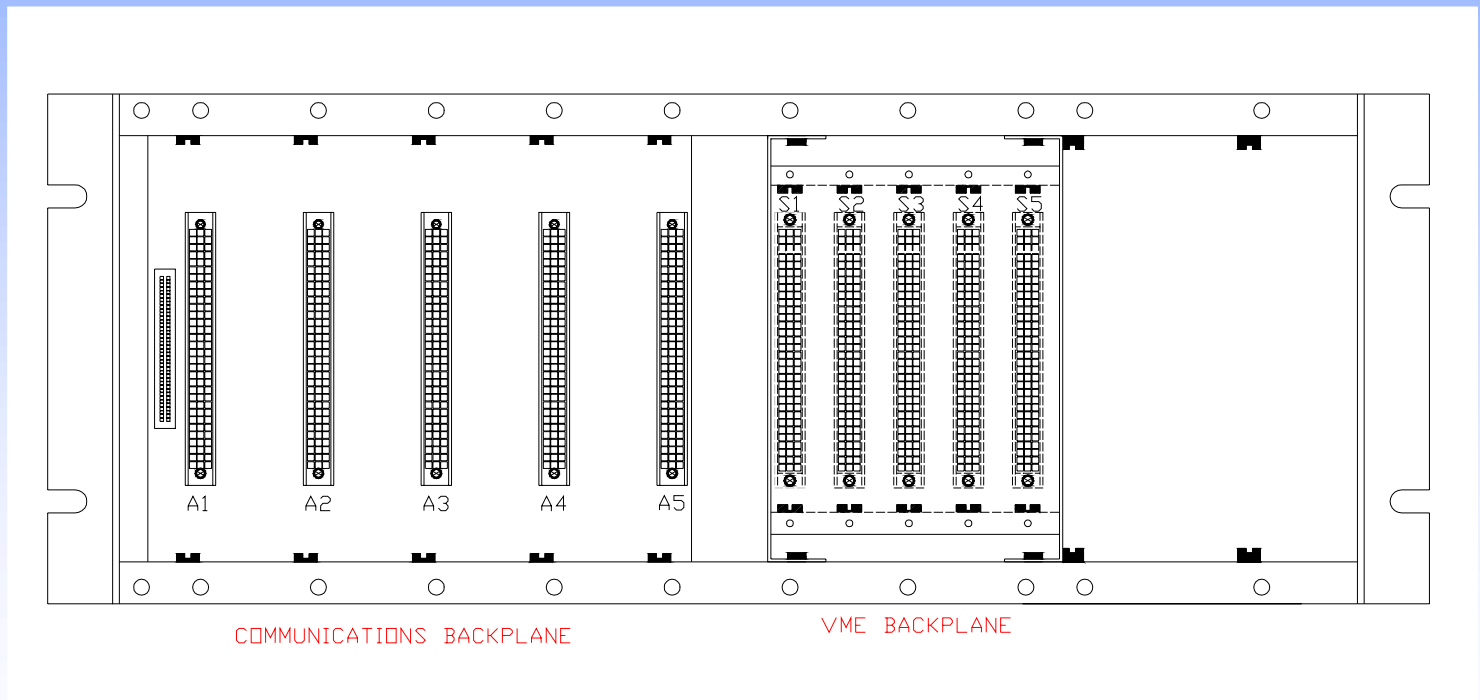


4A AND 4B POWER SUPPLIES CONTINUED



INTERNAL INTERFACE

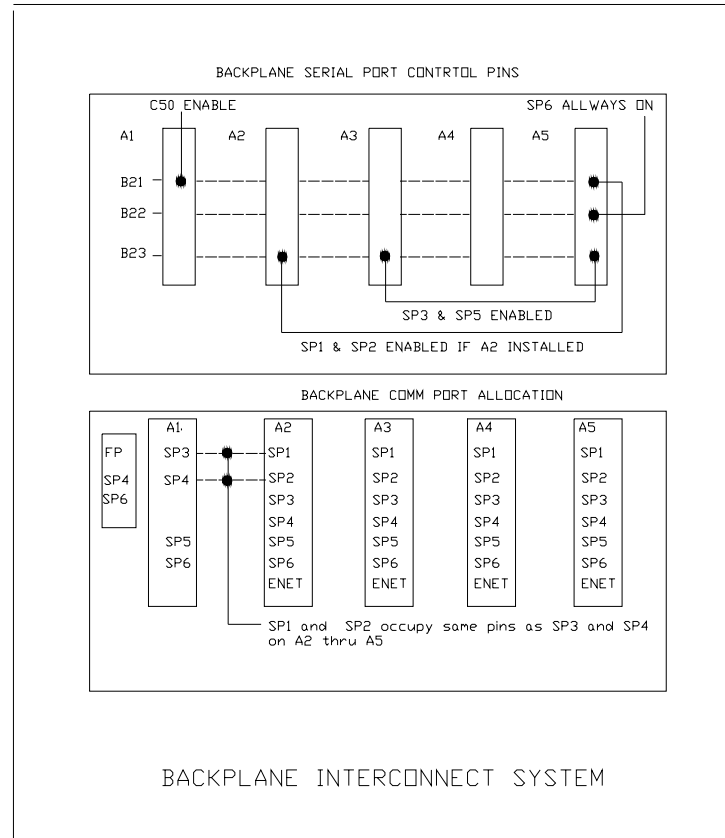
- THE COMMUNICATIONS BACKPLANE CONSISTS OF 5 CONNECTORS.
- A1 REPLACES SERIAL PORTS 1 AND 2 WITH 3 AND 4
- A2 - A5 SUPPORT ALL SERIAL PORTS INCLUDING ENET



SERIAL CONTROL AND INTERFACE

- **THE SERIAL MOTHERBOARD CONSISTS OF 5 “DIN 96 PIN” CONNECTORS ARRANGED AS A1 - A5 AND A 40 PIN HEADER LABELED FP CONNECTOR.**
- **A2 - A5 ARE PARALLEL WIRED TO SUPPORT THE 6 SERIAL PORTS AND CONTROL SIGNALS AND ETHERNET NETWORK.**
- **A1 IS UNIQUE. IT SUPPORTS SERIAL PORTS 3 AND 4 AT THE SAME PIN LOCATIONS IN LIEU OF SERIAL PORTS 1 AND 2.**
- ***THE OBJECTIVE IS TO OPERATE MODEM MODULE IN EITHER SLOTS WITHOUT SPECIAL PIN SELECTION.***

BACKPLANE INTERCONNECT SYSTEM



SESSION 1.7

2070 COMMUNICATIONS MODULES

FLOYD WORKMON



- **THE 2070 INTERNAL BUS PROVIDES 6 SERIAL EIA 485 PORTS PLUS / “ETHERNET” NETWORK**
- **CONNECTIONS A1 - A4 AVAILABLE FOR COMM MODULES**
- **AS NOTED, PORTS 5 AND 6 TYPICAL ASSIGNED TO UNIT FUNCTIONS**
- **PORTS 3 & 4 ARE MULTI-USED**
- **PORTS 1 & 2 (PLUS ETHERNET) AVAILABLE FOR CONTROL AND INT/EXT COMMUNICATION.**

- **4 COMM MODULES SPECIFIED IN CURRENT TEES DOCUMENT**

- **MODEL 2070-6A**
- **MODEL 2070-6B**
- **MODEL 2070-7A**
- **MODEL 2070-7B**

**FIBER OPTIC COMM MODULE
AVAILABLE**

MODEL 2070-6D



- **6A TWO CHANNEL ASYNC MODEM MODULE (LIKE 170 MODEL 800) HALF/FULL DUPLEX 1200 BPS INTERFACES WITH TELEPHONE VOICE GRADE AND DIRECT LINE**
- **6B TWO CHANNEL ASYNC MODEM HALF/FULL DUPLEX UP TO 9600 BPS INTERFACES WITH CONDITIONED TELEPHONE AND DIRECT LINE.**
- **7A TWO CHANNEL ASYNC / SERIAL COMM MODULE INTERFACE EXTERNAL EIA/TIA 232**
- **7B TWO CHANNEL ASYNC / SYNC COMM MODULE INTERFACE EXTERNAL EIA/TIA 485**

- **OTHER MODULES EITHER EXISTING OR PENDING**
 - **2070-6C 1 CHANNEL AUTO DIAL**
1 CHANNEL 400 MODEM
 - **2070-6D 2 CHANNEL FIBER OPTIC**

SESSION 1.8

CALTRANS ATC DAT V 1.0

HARRISON LAM



2070 & ITS CABINET WORKSHOP - AUGUST 2001

CALTRANS ATC DAT V 1.0

- **DEFINITIONS:**

ATC -

ADVANCE TRANSPORTATION CONTROLLER UNIT

DAT -

DIAGNOSTIC ACCEPTANCE TESTS

V 1.0

VERSION 1



CALTRANS ATC DAT V 1.0

- **ATC DAT V 1.0 IS COMPOSED OF
THE EAGLE VALIDATION PROGRAM
AND L.A. DOT TEST PROGRAMS WITH
CERTAIN EDITS**
- **IT IS TARGETED FOR SEPT. 2001 RELEASE**



TESTS:

- TIME-OF-DAY CLOCK & TIMING FUNCTIONS
- SERIAL COMMUNICATIONS
- FIELD I/O (INPUT/OUTPUT)
- SRAM / DRAM MEMORIES
- FLASH MEMORY
- FRONT PANEL ASSEMBLY TEST PROGRAM
- FIELD INPUT / OUTPUT TEST PROGRAM
- INTERNAL TIMERS
- SYSTEM INTERRUPTS & LOGIC FUNCTIONS

LOAD, START

- **USE ANY COMMUNICATION PROGRAM THAT COMES WITH THE KERMIT PROTOCOL**
WE USE MS WINDOWS HYPERTERMINAL
 - * **CONNECT THE 2070 TO THE PC BETWEEN C50S PORT OF THE 2070 WITH COM PORT OF THE LOADING PC**
DEFAULT PORT RATE 9600 BPS
LOAD ATC DAT V 1.0 PROGRAM FILES
POWER ON/OFF
PROGRAM AUTOMATICALLY STARTS

SESSION 1.9

CALTRANS 2070 TESTING FOR QPL ACCEPTANCE

DAVID WELLS



2070 & ITS CABINET WORKSHOP - AUGUST 2001

2070 TESTING

- **PHYSICAL INSPECTION**
- **SOFTWARE INSPECTION**
- **DIAGNOSTIC ACCEPTANCE TESTS**
- **POWER SUPPLY TESTS**
- **ENVIRONMENTAL TESTS**
- **ETHERNET**

PHYSICAL INSPECTION

- **ENSURE ALL DELIVERABLES ARE WITH CONTROLLER**
- **PHYSICAL DIMENSIONS ARE CORRECT**
- **COMPONENTS ARE PROPERLY LABELED**
- **PARTS ARE NO OLDER THAN 3 YEARS**

SOFTWARE INSPECTION

- **ENSURE ALL SOFTWARE MODULES ARE PRESENT**
- **DAYLIGHT SAVINGS**
- **OS-9 VERSION**
- **MEMORY**
- **BOOT UP TIME**
- **TEST ASYNCHRONOUS COMMUNICATION ON EIA-232 AND 485 PORTS**

DIAGNOSTIC ACCEPTANCE TESTS

- **SERIAL PORT LOOPBACK**
- **FIELD IO LOOPBACK**
- **MEMORY (FLASH/DRAM/RAM)**
- **REAL TIME CLOCK**

POWER SUPPLY TESTS

- **POWER SUPPLY VOLTAGES AND LOAD TESTING**
- **ACFAIL AND SYSRESET TIMING SIGNALS**
- **EFFICIENCY**
- **LINESYNC**
- **SHORT OUT**

ENVIRONMENTAL TESTS

- **LOAD AND RUN CALTRANS TRAFFIC CONTROL SIGNAL PROGRAM**
- **TEMPERATURE TESTING +74 C AND -37 C**
- **2 KVA TEST**
- **FRONT PANEL KEYBOARD TEST**

ETHERNET - 2070 LITE ONLY

- **TELNET TO CONTROLLER USING ETHERNET**
- **ADDITIONAL ETHERNET MODULES ARE PRESENT**